

A COMPARISON OF ABSOLUTE PHASE DETERMINATION METHODS

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Cross-track interferometric SAR provides 3-dimensional radar images. The technique relies on determining the target elevation from the slant range difference observed by two antennas having a cross-track separation. The range difference is determined accurately using the phase difference measured from an interferogram obtained from the two complex images. A key problem is that the range difference can only be determined to within a multiple of the wavelength, as the phase difference is measured modulo 2π . We will discuss two different methods to determine the unknown multiple of 2π .

The algorithms are the Split-spectrum Algorithm, and the Residual Delay Estimation Method. The Split-spectrum Algorithm utilizes the carrier frequency dependence of the interferometric phase, splitting the available range bandwidth in two bands provides two slightly different interferograms with a phase difference which corresponds to an interferogram obtained with a system with a carrier frequency which is the difference between the two band centers. This differential interferogram is unambiguous, a fact which can be used to determine the absolute phase of the desired full resolution interferogram.

The Residual Delay Estimation Method is based on the full bandwidth one-look images used to form the interferogram. The first step in the algorithm is to form an interferogram. Then the phase of the interferogram is unwrapped, which is the process of eliminating discontinuities when the phase. The unwrapped phase is identical with the absolute phase with the exception of a constant which is an integer number of 2π . Therefore the unwrapped phase is also proportional to the range difference of the 2 interferometric channels except for a multiple of the wavelength. We use the unwrapped phase to interpolate one channel so that it overlays the other channel. The undetermined multiple of 2π will now show up as a residual range off-set of one channel with respect to the other, an off-set which is independent of position. It is noted that an off-set of one wavelength relative to the (two way) range pixel spacing is typically on the order of a hundredth of a pixel which makes the implementation of the estimation of the residual delay non-trivial.

We will analyze the theoretical advantages and disadvantages of the two algorithms as well as practical considerations from a processor design and an algorithm implementation point of view. We will also compare actual results from applying the algorithms to interferometric SAR data acquired by the JPL TOPSAR system.